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Lend me your arms: The use and implications of humancentric RFID

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Abstract

Recent developments in the area of RFID have seen the technology expand from its role in industrial and animal tagging applications, to being implantable in humans. With a gap in literature identified between current technological development and future humancentric possibility, little has been previously known about the nature of contemporary humancentric applications. By employing usability context analyses in control, convenience and care-related application areas, we begin to piece together a cohesive view of the current development state of humancentric RFID, as detached from predictive conjecture. This is supplemented by an understanding of the market-based, social and ethical concerns which plague the technology.

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1. Introduction

Over the past three decades, Radio-frequency identification (RFID) systems have evolved to become cornerstones of many complex applications. From first beginnings, RFID has been promoted as an innovation in convenience and monitoring efficiencies. Indeed, with RFID supporters predicting the growth of key medical services and security systems, manufacturers are representing the devices as ‘life-enhancing’. Though the lifestyle benefits have long been known, only recently have humans become both integral and interactive components in RFID systems. Where we once carried smart cards or embedded devices interwoven in clothing, RFID technology is now at a point where humans can safely be implanted with small transponders.

This paper aims to explore the current state of development for humancentric applications of RFID. The current state is defined by the intersection of existing development for the subjects and objects of RFID – namely humans and implants. The need for such a study has been identified by a gap in knowledge between present applications and future

possibility. This study aims to overcome forecast and provide a cohesive examination of existing humancentric RFID applications. Analysis of future possibility is outside the scope of this study. Instead, a discussion will be provided on present applications, their feasibility, use and social implications.

2. Literature review

The literature review is organized into three main areas – control, convenience, and care. In each of these contexts, literature will be reviewed chronologically.

2.1. The context of control

A control-related humancentric application of RFID is any human use of an implanted RFID transponder that allows an implantee to have power over an aspect of their lives, or, that allows a third party to have power over an implantee. Substantial literature on humancentric control applications begins in 1997 with United States patent 5629678 for a ‘Personal Tracking and Recovery System’. Though the literature scientifically describes the theoretical tracking system for recovery of RFID-implanted humans,

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no further evidence is available to ascertain whether it has since been developed. Questions as to feasibility of use are not necessarily answered by succeeding literature. Reports of the implantation of British soldiers [1] for example lack the evidentiary support needed to assuage doubts. Further, many articles highlight the technological obstacles besieging humancentric RFID systems. These include GPS hardware miniaturization [2] and creating active RFID tags capable of being safely recharged from within the body. Further adding to reservation, much literature is speculative in nature. Eng [3], for example, predicts that tags will be melded into children to advise parents of their location.

Despite concerns and conjecture, actual implementations of humancentric control applications of RFID have been identified. Both Murray [4] and Eng documented the implantation of Richard Seelig who had tags placed in his hip and arm in response to the September 11 tragedy of 2001. This sophisticated technology was employed to provide security and control over personal identification information. Wilson [5] also provides the example of 11-year old Danielle Duval who has had an active chip (i.e. containing a rechargeable battery) implanted in her. Her mother believes that it is no different to tracking a stolen car, simply that it is being used for another more important application.

2.2. *The context of convenience*

A convenience-related humancentric application of RFID is any human use of an implanted RFID transponder that increases the ease with which tasks are performed. The first major documented experiment into the use of human-implantable RFID was within this context. Sanchez-Klein [6] and Witt [7] both journalize on the self-implantation of Kevin Warwick, Director of Cybernetics at the University of Reading. They describe results of Warwick's research by his having doors open, lights switch on and computers respond to the presence of the microchip. Warwick himself gives a review of the research in his article 'Cyborg 1.0', however this report is informal and contains emotive descriptions of "fantastic" experiences [8].

Woolnaugh [9], Holden [10], and Vogel [11] all published accounts of the lead-up to Warwick's second 'Cyborg 2.0' experiment and although Woolnaugh's work involves the documentation of an interview, all three are narrative descriptions of proposed events rather than a critical analysis within definitive research frameworks. Though the commotion surrounding Warwick later died down, speculation did not with Eng proposing a future where credit card features will be available in implanted RFID devices. The result would see commercial transactions made more convenient.

2.3. *The context of care*

A care-related humancentric application of RFID is any human use of an implanted RFID transponder where function is associated with medicine, health or wellbeing. In initial literature, after the Cyborg 1.0 trial, Kevin Warwick

envisioned that with RFID implants paraplegics would walk [7]. Building incrementally on this notion then is the work of Kobetic, Triolo and Uhler who documented the study of a paraplegic male who had muscular stimuli delivered via an implanted RFID controlled electrical simulation system [12]. Though not allowing the mobility which Warwick dreamt of, results did include increased energy and fitness for the patient.

Outside the research sphere, much literature centers on eight volunteers who were implanted with commercial VeriChip RFID devices in 2002 trials. Murray [13], Black [14], Grossman [15] and Gengler [16] all document medical reasons behind the implantation of four subjects. Supplemented by press releases however, all reports of the trials were journalistic, rather than research-based. In contrast, non-trivial research is found in the work of Michael [17]. Her thesis uses a case study methodology, and a systems of innovation framework, to discuss the adaptation of auto-ID for medical implants.

2.4. *Critical response to literature*

More recent publications on humancentric RFID include the works of Masters [18], Michael and Michael [19], Perusco and Michael [20], Johnston [21], and Perakslis and Wolk [22]. Masters approaches the subject from the perspective of usability contexts, while Perusco and Michael use document analysis to categorise location services into tag, track and trace applications. Johnston uses content analysis to identify important themes in the literature, supplemented by a small-scale sample survey on the social acceptance of chip implants. Perakslis and Wolk also follow this latter methodology. Of the other (earlier) landmark studies, the majority are concerned with non-humancentric applications. Gerdeman [23], Finkinzeller [24] and Geers [25] all use case studies to investigate non-humancentric RFID and hence our methodological precedent is set here. The bulk of the remaining literature is newtype in nature and the absence of research frameworks is evident. The few exceptions to this include Woolnaugh [9] who conducted an interview and Murray [13] and Eng [3] who provide small case studies. In further criticism the news articles do not demonstrate technological trajectories but speculate on utopian implementations unlikely to be achieved by incremental development in the short to medium-term. Thus, any real value in these news articles can only be found in the documentation of events.

3. **Research methodology**

Several modes of academic inquiry were used in this study, though usability context analyses were the focal means of research. These analyses are similar to case studies as they investigate "a contemporary phenomenon within its real life context when the boundaries between phenomenon and context are not clearly evident" [26]. They also similarly use multiple sources of evidence, however are differentiated on the basis of the unit of analysis.

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380138	Lend me your arms: The use and implications of humancentric RFID	11

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